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MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS FROM DRY CREEK, RUSSIAN RIVER BASIN, CALIFORNIA

Public Health Service
San Francisco, California

December 1960

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MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

YUBA BEAR CREEK DOUGLAS RIVER BASIN CALIFORNIA

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region IX
San Francisco, California

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District, San Francisco Calif.

December 1960

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INTRODUCTION

General

The Department of the Army and the Department of Health, Education, and Welfare have entered into a formal Memorandum of Agreement dated November 4, 1958, in regard to the Water Supply Act of 1958. This Act requires the Corps of Engineers and the Bureau of Reclamation to consider storage for municipal and industrial water supply purposes in planning for reservoir developments under their respective jurisdictions. The Memorandum states that the Public Health Service of the Department of Health, Education, and Welfare shall provide the Corps of Engineers of the Department of the Army with advice and assistance in regard to the amount of storage to be provided in the reservoirs and on the economic value of the storage.

The District Engineer of the Corps of Engineers, U. S. Army Engineer District, San Francisco, requested the Public Health Service by letter of August 18, 1960, under the terms of the Memorandum to study the proposed dam and reservoir on Dry Creek of the Russian River in Sonoma County, California. This report states the determinations and conclusions of the Public Health Service in regard to that study and includes pertinent observations and comment on water quality, waste disposal, and other factors affecting the water supply situation.

Acknowledgments

The Public Health Service wishes to acknowledge the assistance and cooperation provided by various State and local government agencies, including the State Department of Water Resources, the State Department of Public Health, the North Coastal Regional Water Pollution Control Board, the Sonoma County Flood Control and Water Conservation District, the North Marin County Water District, the Marin Municipal Water District, and others. Officials and staff members of these agencies provided valuable guidance and information and allowed time for discussion and the examination of documents and reports from their files.

CONCLUSIONS

1. Water for municipal and industrial uses in Marin and Sonoma Counties will be needed in about 1980 in addition to the supply available from present or planned developments such as the Coyote Project and related aqueducts in Sonoma County and the Nicasio Project in Marin County.

2. The 75,000 acre feet per year available for municipal and industrial use from the proposed multiple-purpose Dry Creek Project will supply these additional needs until approximately 2005.

3. The quality of Russian River water downstream from Dry Creek is satisfactory for municipal and industrial water supply uses. The maintenance of acceptable quality will require the continued careful attention of the responsible agencies as the magnitude of waste flows increase with population and economic growth in the Russian River Basin.

4. Based on the analysis of alternate sources for water supply for Marin and Sonoma Counties, the average value of future benefits (beginning in 1980) from municipal and industrial water supply from the proposed multiple-purpose Dry Creek Project is $12.22 per acre foot, or 3.75 cents per thousand gallons. This average value should be discounted from 1980 to the present or some other date to be determined by the Corps of Engineers as appropriate for comparison with other benefits and costs associated with the proposed project. Further details are included in the last section of this report.

DESCRIPTION OF PROJECT

Dry Creek drains a rugged, mountainous area situated in the southwestern portion of the Russian River Basin and discharges into Russian River just downstream from the city of Healdsburg. The Dry Creek Basin is about 32 miles in length and averages 12 miles in width. It is the second largest tributary area of the Russian River watershed, and probably contributes the largest annual runoff. Drainage area above the confluence with Russian River is about 218 square miles. In the lower 14 miles, Dry Creek flows through a relatively level valley about one mile in width.

The proposed project is the Multiple-Purpose Warm Springs Dam on Dry Creek, Russian River Basin, in Sonoma County. It consists of construction of an earthfill dam about 14 miles above the mouth of Dry Creek near the upstream limits of the agricultural area. The dam is to be located just below the confluence with Warm Springs Creek, a major tributary, the runoff of which will be included in the impoundment. Total drainage area behind the dam is 130 square miles.

The dam would be used for purposes of providing flood control and creating a new water supply for domestic and industrial uses. It would have a crest elevation of 487 feet msl, a crest length of 2,830 feet, and would rise 285 feet above streambed. Lake Sonoma , which would be formed by the dam, would have a gross storage of 270,000 acre feet allocated to use as follows:

Silt reservation	7,000 acre feet
Minimum pool	13,000 acre feet
Water supply	125,000 acre feet
Flood control	125,000 acre feet

At times when the water supply pool is full, the lake will have an area of 1,850 acres.

Recreation is expected to be an important development as a result of the project. Basic facilities will be included for the pursuit of aquatic sports, camping and picnicking. It is probable that local interest groups will develop permanent facilities for recreation in addition to the basic facilities that would be provided by the Government.

The storage of 125,000 acre feet for water supply is expected to yield 90,000 acre feet annually. The basis for development considers that, of this total, about 75,000 acre feet annually would be on a relatively uniform demand such as domestic and industrial water supply and 15,000 acre feet annually

on a demand basis similar to that required for agricultural uses. In addition, minimum flows of 25 cfs each would be assured for mitigation of damage to sports fisheries and for local uses along Dry Creek below the dam. The minimum pool of 13,000 acre feet of storage is provided as a fisheries enhancement feature.

Water for all uses would be released into Dry Creek immediately below the dam and would then flow the 14 miles to Russian River whence it would flow an additional seven miles to the existing Ranny Water Collectors near Wohler Bridge or other collectors which might be installed near Mirabel. From this point water distribution would be through the aqueduct system local interests are developing.

DESCCRIPTION OF THE STUDY AREA

The Russian River rises in the mountains of Mendocino County north of the communities of Ukiah and Redwood Valley and flows south for approximately 70 miles into Sonoma County where it turns westward in the vicinity of Healdsburg and flows 35 miles farther to the Pacific Ocean. Dry Creek is a tributary of the river, entering from the west at a point one mile south of Healdsburg. The drainage area has moderate to heavy rainfall, from 20 to 50 inches, according to the mean annual precipitation for the 50 year period 1897--1947. Large fluctuations from season to season and within the season create problems which require control to prevent flooding and conserve water.

The study of water demand area lies chiefly within Sonoma and Marin Counties, which lie north and west of San Francisco and San Pablo Bays. A small part of Mendocino County (to the north of Sonoma County) lying in the valley of the Russian River below Coyote Dam is also included. Further study will be required to determine whether Napa County, to the east of Sonoma County, will require Russian River water.

The terrain of the area varies from mountains to hilly to broad level valleys. The climate is mild with warm summers and snow-free winters in the valley areas and only occasional snows in the mountains.

ECONOMICS AND POPULATION

Economic Base

The economy of the upper watershed is based primarily on forest products and agriculture characterized by ranches, orchards, and vineyards in the high ground and truck crops in the valleys. Ukiah, the county seat of Mendocino county, with U.S. Census Bureau 1960 population of 9,820, is the trade and service center for this water demand area.

Sonoma County has a more varied economy. Agriculture is important, particularly in orchard and truck crops. The non-agricultural base consists of light industry such as food processing, wood working, metal fabricating, and cement plants. Personal and business services, the distribution of goods, and the retail trades employ the major share of the labor force, however. The extent of employment outside the county in San Francisco and its immediate vicinity has not been determined. Certainly a large share of the labor force at the southern end of the county is probably employed in this manner. The county is not, however, strictly a dormitory operation though a large portion has definite suburban characteristics.

Marin County, particularly in the portions adjacent to San Pablo Bay and the immediate San Francisco area, is a more positive mixture of suburbia and light industrial activity. The exact proportions of this mixture have not been established. A more elaborate, detailed study involving interviewing techniques would be necessary to make this determination.

Table 1 shows the population of each county and township according to the U.S. Bureau of the Census 1960 preliminary count.

TABLE 1

STUDY AREA 1960 POPULATIONS *

		Total
Mendocino County		50,562
Ukiah (County seat, not a township)	9,820	
Marin County		145,545
Novato Township	24,000	
San Rafael Township	78,500	
Sausalito Township	40,000	
Tomales Township	3,000	
Sonoma County		145,789
Analy Township	16,000	
Cloverdale Township	4,000	
Healdsburg Township	12,000	
Petaluma Township	22,000	
Redwood Township	4,000	
Santa Rosa Township	62,500	
Sonoma Township	25,000	

* The county totals are U.S. Bureau of Census, 1960 preliminary counts. The township figures are based on estimates of U.S. Department of Commerce adjusted to the 1960 Census preliminary counts. The Ukiah population figure is the 1960 U.S. Census Bureau's preliminary count.

Future Growth

The major impetus for economic growth in the study area will be provided by the further extension of the activities of the metropolitan core. The availability of large land areas for urban and commercial-industrial development and the saturation of such areas close to the core will be the immediate factors involved. Therefore, development will follow generally the present pattern, moving from the southerly ends of the counties northward. Current population centers will constitute the nuclei which will blend together as time and density increase. The growth of the present small communities and their proximity to the larger ones will enhance considerably the possibility of water service from a central agency or a few such agencies.

The population projections in Table 2 are based on the U.S. Department of Commerce Report, Future Development of the San Francisco Bay Area--1960-2020, published in December 1959. A close examination of this report augmented by discussions with officials in the several sections of the study area and studies of reports of consulting engineers and other agencies indicates that the general premises and conclusions of the Commerce report are acceptable. Considerable weight was given also, in judging the growth potential, to experience gained in other areas of the United States on similar studies and to knowledge of projections of the national economy made by various public and private groups. In other words, the study area is expected to follow a developmental pattern similar to that occurring in other large metropolitan areas with much of the economic activity associated with maintaining the production, functions, and services of the area itself and a lesser but important share of the activity dependent on national economic conditions.

TABLE 2

STUDY AREA POPULATION PROJECTIONS (IN THOUSANDS)*

	1970	1980	1990	2000	2010	2020
Mendocino County	70	85	100	110	120	125
Ukiah (county seat)	15	20	26	30	35	40
Marin County						
Novato Township	40	55	70	85	150	205
San Rafael Township	86	112	140	165	250	325
Sausalito Township	46	70	100	105	135	160
Tomales Township	3	8	20	30	35	60
Total	175	245	330	385	570	750
Sonoma County						
Analy Township	20	35	48	60	122	178
Cloverdale Township	6	8	12	18	30	48
Healdsburg Township	14	20	30	40	73	106
Petaluma Township	26	42	104	120	184	244
Redwood Township	6	7	8	9	16	25
Santa Rosa Township	78	150	216	232	306	368
Sonoma Township	28	38	50	61	107	145
Total	178	300	468	540	838	1,114

* Except for Ukiah in Mendocino County, these projections are based on adjustments of U.S. Department of Commerce figures reported in Future Development of the San Francisco Bay Area--1960-2020, published in December 1959. The adjustments take into account the 1960 U.S. Census Bureau's preliminary counts and variations noted from other projections.

The projection for Ukiah is based on unpublished information obtained from the U.S. Department of Commerce.

FUTURE WATER REQUIREMENTS

In Appendix A, present water supplies and previous studies of municipal and industrial water supply needs for various community water purveyors in Mendicino, Sonoma and Marin Counties are reviewed and evaluated as related to proposed additional development of supply in the Russian River Basin and distribution therefrom by aqueducts. The studies and the necessary supplemental estimates, as might be expected, are based on different assumptions as well as different methods for projecting populations and water requirements. The results of some of these studies currently are being reviewed and revised in the light of preliminary 1960 census data and the U.S. Department of Commerce Report, Future Development of the San Francisco Bay Area--1960-2020, published in December 1959. For this investigation and report, therefore, it has been decided only to use the conclusions resulting from the review and evaluation of these earlier studies as a check against a gross estimate of municipal and industrial water requirements based entirely on the previously mentioned Department of Commerce projections (Tables 3 and 4).

Mendocino County

As pointed out in Appendix A, Mendocino County has purchased storage sufficient for 8,000 acre feet of annual yield in the Russian River Coyote Project. The service area for this water is the southern part of the county, particularly the city of Ukiah and vicinity. It appears that the expected population growth in this area can be supplied satisfactorily by this amount of water throughout most if not all of the projection period. Any deficit in later years would not change the total gross estimate significantly.

Sonoma County

Department of Commerce population projections for Sonoma County increase from 178,000 in 1970 to 1,114,000 in 2020. It is anticipated that the population served from ground water by community systems such as Healdsburg, as well as those fringe areas, etc., served by individual wells, will reach a maximum of approximately 100,000 in 1990. It is reasonable to expect that the differences in these projected populations will be located in present or future aqueduct service areas.

Unit water use, including allowance for domestic, commercial, industrial and public use, is expected to increase rather uniformly over the projection period to an estimated 170 gallons per capita per day in 2020. Application of the unit water use figures for each decade results in the total annual water use for present and potential aqueduct service areas in Sonoma County, reaching 193,000 acre feet in 2020.

Quantities available from existing or planned surface and ground water sources, including all assigned and unassigned water from the Coyote Project, are expected to meet the demand through 1980. Deficits in subsequent decades are defined as the gross needs to be served by additional water development in the Russian River Basin. In 2020 the gross needs are estimated to be 124,000 acre feet per year. The step-by-step development of gross water needs in Sonoma County for the next sixty years is shown in Table 3.

Marin County

It is anticipated that the significant portion of Marin County's population to be served by organized water districts will continue to be in Novato, San Rafael and Sausalito Townships (i.e., excluding Tomales Township). Department of Commerce projections for these townships increase to 750,000 in 2020.

Unit water use, presently higher than in Sonoma County, is expected to peak at about 170 gallons per capita per day in 1990, remaining essentially the same thereafter. Based on this assumed unit water use, which includes allowance for commercial, industrial, and public, as well as domestic use, the total annual water use for present and potential water district service areas is estimated to reach 143,000 acre feet per year in 2020.

Existing or planned surface and ground water supplies are expected to be adequate to satisfy the demand in the two Marin County Districts until after 1970. Marin Municipal Water District (MMWD) is expected to have need for additional water first. However, it is anticipated that at the same time North Marin County Water District will have some surplus water from the amount already under contract from Sonoma County Flood Control and Water Conservation District. This gross water requirements projection assumes MMWD can acquire the surplus temporarily until about 1980 when additional water must be developed or imported for both districts.

Subsequent to 1980 the gross water needs to be served by additional Russian River Basin water development are expected to increase to 100,000 acre feet per year in 2020. Table 4 shows the step-by-step development of gross water needs in Marin County for the next sixty years.

TABLE 3

SONOMA COUNTY
GROSS ESTIMATE OF MUNICIPAL AND INDUSTRIAL WATER SUPPLY NEEDS
FROM ADDITIONAL RUSSIAN RIVER WATER DEVELOPMENT

Year	1970	1980	1990	2000	2010	2020
County Population	178,000	300,000	468,000	540,000	838,000	1,114,000
Population to be Served Exclusively by Wells (in communities, as well as fringe areas, etc.)	70,000	85,000	100,000	100,000	100,000	100,000
Difference (i.e., population in service areas to be supplied by aqueducts)	108,000	215,000	368,000	440,000	738,000	1,014,000
Unit Water Use (gal. per capita per day)	125	130	140	150	160	170
Annual Water Use (acre feet per year)	15,500	31,500	57,500	74,000	132,000	193,000
Existing or Planned Surface and Ground Supplies Used to Meet Demands (acre feet per year) 1/	27,500	33,000	39,500	47,000	58,000	69,000
Gross Needs to be Served by Additional Russian River Water Development (acre feet per year)	-	-	18,000	27,000	74,000	124,000

1/ Including 11,000 acre feet of unassigned Sonoma County water from existing Coyote Project.

TABLE 4

MARIN COUNTY

GROSS ESTIMATE OF MUNICIPAL AND INDUSTRIAL WATER SUPPLY NEEDS
FROM ADDITIONAL RUSSIAN RIVER WATER DEVELOPMENT

Year	1970	1980	1990	2000	2010	2020
County Population (excluding Tomales Township)	175,000	245,000	330,000	385,000	570,000	750,000
Unit Water Use (gal. per capita per day)	150	160	170	170	170	170
Annual Water Use (acre feet)	29,500	44,000	63,000	73,000	109,000	143,000
Existing or Planned Surface and Ground Supplies Used to Meet Demands (acre feet per year) 1/	43,000	43,000	43,000	43,000	43,000	43,000
Gross Needs to be Served by Additional Russian River Water Development (acre feet) 2/	-	1,000 3/	20,000	30,000	66,000	100,000

1/ Includes estimated ultimate of 1,000 acre feet from water district system wells.

2/ Marin Municipal Water District (MMWD) is expected to need additional water at a time when North Marin County Water District is expected to have a surplus from the amount already under contract from Sonoma Co. This gross estimate assumes MMWD can acquire this surplus temporarily and the necessary aqueducts will be constructed.

3/ Temporarily on a year-to-year contract surplus water might be available from unassigned Sonoma Co. Coyote Project supply to satisfy this need, assuming necessary aqueducts are constructed to serve MMWD.

Combined Gross Needs, Sonoma and Marin Counties

Figure 1 shows the combined gross needs of Sonoma and Marin Counties for additional water from future development of supply in the Russian River Basin. The needs are expected to first appear in about 1980 and grow to 224,000 acre feet annually by 2020.

Also shown in Figure 1 is the estimate of water needs based on other studies with some modifications as compiled in Appendix A. It checks reasonably well with the gross appraisal based on Department of Commerce population projections.

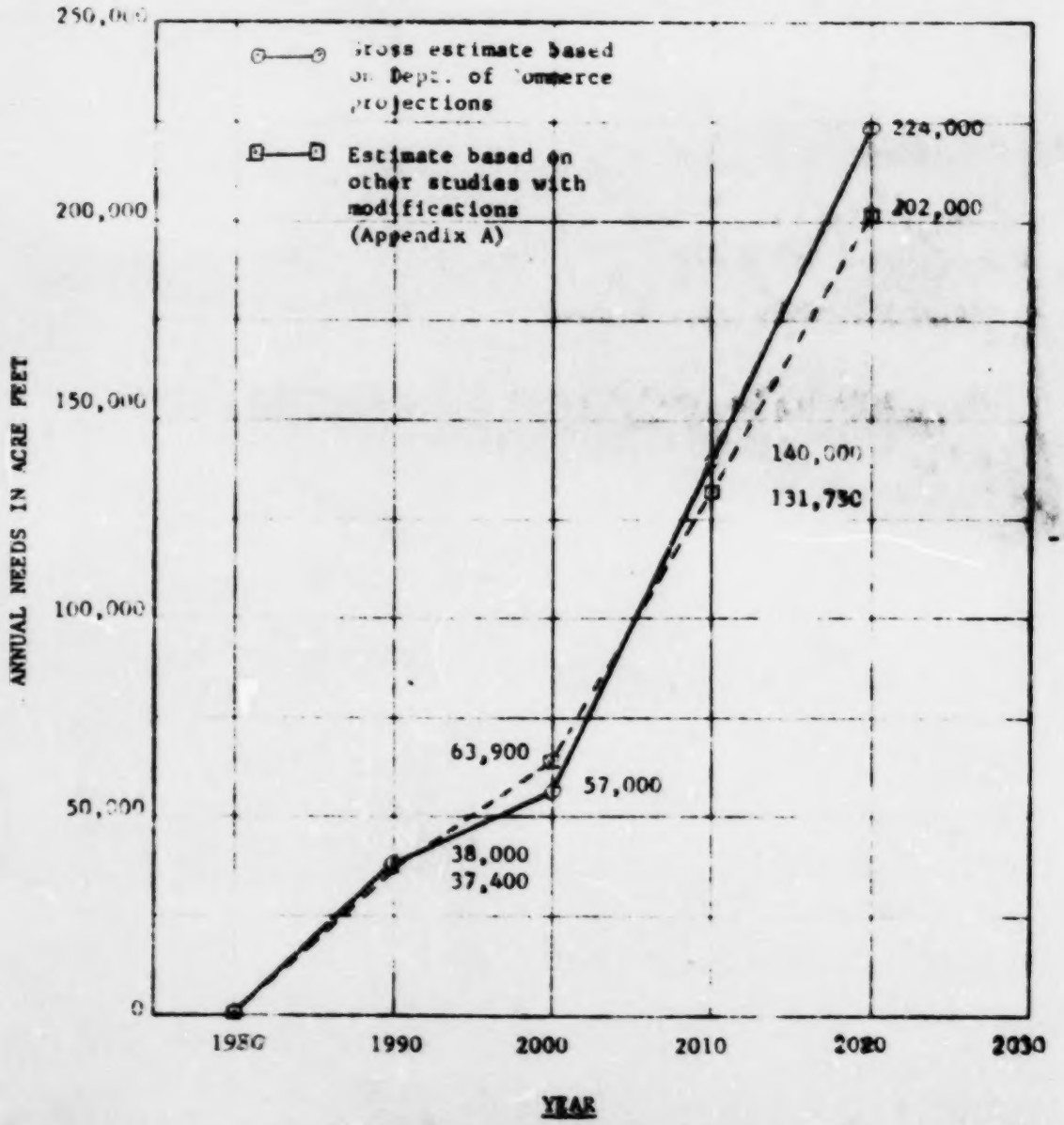
The proposed dam and reservoir on Dry Creek would make available an additional 75,000 acre feet annually for municipal and industrial uses. Thus the gross needs of Sonoma and Marin Counties as estimated herein could be met with water from this project until some time between the years 2000 and 2005.

Figure 1

MARIN AND SONOMA COUNTIES

TOTAL MUNICIPAL AND INDUSTRIAL WATER SUPPLY NEEDS

FROM ADDITIONAL RUSSIAN RIVER DEVELOPMENT



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WATER QUALITY

The quality of Russian River water downstream from Dry Creek is good at present and should remain so if protection from pollution is continued. Quality characteristics of importance to municipal and industrial water uses are summarized in Table 5, based on data obtained from the California Department of Water Resources. The mineral quality meets the present U.S. Public Health Service Drinking Water Standards and the proposed revision as well.

Although the surface water in the Russian River would require complete treatment (i.e., coagulation, sedimentation, filtration and chlorination) to assure satisfactory bacteriological quality and palatability prior to domestic use, the ground water underflow in the new alluvium of the flood plain requires only chlorination. The Sonoma County Flood Control and Water Conservation District presently obtains its supply at Wohler Bridge from this ground water underflow through perforated intake pipes located some sixty feet below the stream bed and chlorinates at the pumping plant.

The North Coastal Regional Water Pollution Control Board states that no significant municipal and industrial waste discharges reach the Russian River without adequate treatment. Most municipal discharges (including industrial wastes discharged to the municipal systems) are applied to land after treatment during low flow in the river in the dry season. Information on municipal waste treatment facilities is shown in Table 6. Data available from the North Coastal Regional Water Pollution Control Board indicates that only one industry (Ukiah Masonite) is discharging waste water directly to the Russian River, the amount of which is negligible.

Some wastes from private domestic waste disposal systems may reach the Russian River from such communities as Forestville, Geyserville, Guernewood Park, Asti, Guerneville, Vacation Beach, Monte Rio, Rio Nido, and Villa Grande. These are small communities but they present a serious potential problem as they are mostly resort areas with populations swelling to many thousands during the summer vacation season.

The potential effect of pollution on recreational use of the Russian River is considerable unless the undesirable organic and inorganic wastes resulting from projected population and economic growth are applied to land or otherwise kept out of the river. Recreation is a major economic resource of the area which, to a large extent, is dependent upon the river. The maintenance and expansion of this resource requires prevention of pollution of the water and maintenance of adequate flows during the dry season. These two factors significantly affect the fisheries which provide a major tourist attraction in the area.

TABLE 5

WATER QUALITY - RUSSIAN RIVER*

	Temp. Deg.F	Dissolved Oxygen (ppm)	Dissolved Oxygen (% of Saturation)	pH	Calcium (ppm)	Magnesium (ppm)	Chlorides (ppm)	Sulfates (ppm)	Nitrates (ppm)	Fluorides (ppm)	Total Hardness as $CaCO_3$ (ppm)	Coliforms (MPN/ml.)
Near Healdsburg, Calif.												
Maximum	77	11.2	118	7.9	25	35	14.0	11.0	1.5	0.1	142	2400
Minimum	47	7.5	83	7.0	23	12	4.0	7.2	0	0.0	80	0.06
Mean	65	9.1	94	7.6	23	24	6.1	8.9	0.9	0.0	110	23 (Median)
Near Guerneville, Calif.												
Maximum	78	10.3	93	7.9	30	36	13.0	13.0	1.0	0.1	147	7200
Minimum	48	7.6	85	7.1	23	10	5.0	9.0	0.4	0.0	40	0.045
Mean	65	8.5	89	7.4	26	24	6.8	11.7	0.6	0.0	111	8 (Median)

*Based on monthly analyses except for Calcium, Sulfates and Nitrates, which were approximately every 6 months, and coliforms, which were bi-monthly--period of record March 1959 to August 1960--data from California Department of Water Resources.

TABLE 6

MUNICIPAL WASTE TREATMENT FACILITIES
RUSSIAN RIVER BASIN - 1960*

Municipality	Population Served	Avg. Daily Flow (MGD)	Pop. Equiv. (BOD) Untreated Waste / Treated Waste	Treatment Facilities	Discharge To
Cloverdale	3500 E	0.5	50	2-stage Bio-filtration, Lagoons, Chlor, Eff.	Russian River year around
Ukiah	9820		10,000 / 730	Aeration, Sed., Filt., Digest., Lagoons	Land in summer, Russian River in winter
Calpella	365	X	X	Imhoff tank & Percola-tion Beds	No over-flow from beds in summer, Russian River in winter
Santa Rosa		4.9	50	Preaer., Sed., Trick. Filt., Ox. Pond, Digest.	Land in summer, Russian River Trib. in winter
Sebastopol	2500	X	3,000 / 300	Sed., Digest., Filt., Oxida-tion Ponds	Laguna de Santa Rosa
Healdsburg	5000	0.5	X	Pri.& Sec. Clarif. Bio-filt., Digest. Chlo.	Land in summer, Russian River in winter

* Data from files of North Coastal Regional Water Pollution Control Board, Santa Rosa, Calif., and 1957 Inventory of Municipal and Industrial Waste Facilities, DHEW, Public Health Service.

The location of the discharge intake of the proposed Dry Creek reservoir can have an effect on the dissolved oxygen content of the releases. If thermal stratification takes place in the summer, as it frequently does in such storage reservoirs, the dissolved oxygen may become quite low or entirely depleted in the colder, denser bottom stratum. Sufficient sunlight to promote photosynthesis will not reach the bottom, and oxygen removed by decomposition of organic matter will not be replaced. Consideration should be given, therefore, to design of the discharge intake so as to permit withdrawal of water from the surface stratum, with its high oxygen content, regardless of the reservoir water surface level.

VALUE OF STORAGE

General

Aqueducts already in existence, under construction and planned for diverting the presently augmented flow in the Russian River from the Coyote Dam Project on the East Fork, plus the almost completed Nicasio Project (Marin Municipal Water District), are expected to take care of the major future needs in Marin and Sonoma Counties until approximately 1975 or 1980.

A previous section of this report has estimated water requirements of the two counties further into the future which might be served from additional water development in the Russian River Basin, notably the proposed reservoir on Dry Creek. The Corps of Engineers study of the Dry Creek Basin indicates that an additional 75,000 acre feet can be made available annually for municipal and industrial uses.

The physical feasibility of meeting future needs subsequent to 1980 from the proposed Dry Creek Project and additional aqueducts is evident. However, there remains the question of economic feasibility which leads to consideration of the monetary value, or benefits, of the proposed additional water development.

Efforts to approach this problem on the basis of market value of water have been unsuccessful. The cost of impoundment is typically a small part of the costs of providing water service experienced by a municipal water supply company. Attempts to assign values for water in different uses encounter such insurmountable (at present) problems as determining the value of drinking water (whose value appears to be immeasurable).

It has been said that the limiting value of works constructed for the improvement of water supply is the maximum amount prudent users would be willing to pay for the improved or augmented service. However, precise measurement of benefits on this basis is impracticable at the present time. This concept does, however, serve to place a ceiling (based on judgment) on the value of storage determined by the "alternative-cost" method.

The Alternative-Cost Doctrine

The 1958 report of the Subcommittee on Evaluation Standards of the Inter-Agency Committee on Water Resources entitled "Proposed Practices for Economic Analysis of River Basin Projects" (commonly known as the "Green Book") states: "From an overall public viewpoint, a...water supply development will be economically

justified if it provides water to meet expected needs at a cost not greater than the cost of the alternative source that would likely be utilized in the absence of the project." The problem which must be faced is the determination of the "likely" alternative source.

"Likely" alternate sources for Sonoma County might be the North Bay Aqueduct (a feature of the California Department of Water Resources' plan for the San Francisco Bay Area) and a single-purpose storage reservoir (i.e., for water supply only) on Dry Creek in the Russian River Basin. In addition to these two sources, a third alternate source for Marin County might be water storage in the Walker Creek Basin in the western part of the county.

The California Water Plan includes consideration of additional diversion of Eel River water to the Russian River for Marin and Sonoma Counties. However, for the purposes of this report, this proposal is considered as a subsequent stage to the ultimate development of the Russian River Basin.

The previously mentioned possible alternates are compared in the following sections for the purpose of choosing the <u>likely alternate</u>. This <u>likely alternate</u> can then be used as a basis for determining the value of water yield for municipal and industrial use from the proposed Corps of Engineers Dry Creek Project. Since cost will be used as the criterion for choosing the likely alternate, the estimates in the comparisons must include costs of transmission to common points of use. Marin County is farthest from the Russian River and the most likely to utilize other sources, so the cost comparisons are made for the two districts in that county only.

<u>Alternate I - Walker Creek (Marin County)</u>

The development of the Walker Creek Basin has been considered by both Marin Municipal and North Marin County Water Districts as a potential source of supply to meet future needs. Previous preliminary studies have indicated that safe yields from 5,000 to 26,000 acre feet per year could be obtained.

North Marin County Water District rejected the possibility of constructing both a large reservoir on Walker Creek near Tomales and a smaller reservoir on Arroyo Sausal, a principal tributary. Both sources were considered to be less desirable financially than the aquisition of Russian River water from the Sonoma County Flood Control and Water Conservation District.

The Marin Municipal Water District made a preliminary appraisal of the development of water from Walker Creek in 1959. The District concluded that the cost of development and transmission of <u>untreated</u>

water into its boundaries would be from $45 to $50. Using the technique of Orlob and Lindorf for California cities [1/], the cost of complete treatment (including amortization of the plant cost plus operation and maintenance) at present day prices is estimated to range from $7 - $17 per acre foot. Total cost for water from Walker Creek therefore would be from $52 - $67 per acre foot.

Alternate II - North Bay Aqueduct

The North Bay Aqueduct as proposed by the California Department of Water Resources would divert water from Lindsey Slough, a tributary to the Sacramento River above Rio Vista, through some sixty miles of facilities which would terminate in a small reservoir near Novato. The delivery of water to this reservoir would be about 100 cubic feet per second (approximately 72,000 acre feet per year). This is roughly equivalent to the municipal and industrial water available from the proposed Dry Creek Project.

In its 1957 "Interim Report on the Salinity Control Barrier Investigation," the California Department of Water Resources estimated an average water rate of about $10.50 per acre foot would be required to meet the costs during the repayment period. A rate of $30 per acre foot was assigned to municipal and industrial water to permit an irrigation water rate of $3.50 per acre foot which was considered a reasonable maximum for agricultural use. The Department is a gain studying this aqueduct and based on its latest preliminary estimate, stated in a letter to the Public Health Service in October 1960, that the cost of water in Marin County would be from $24 to $28 per acre foot and from $20 to $24 per acre foot in Sonoma County. These rates are for untreated water.

North Marin County Water District (NMCWD) considered the North Bay Aqueduct prior to contracting for Russian River water but rejected it as being an unreliable source to meet immediate future needs. It still can be considered as a possible alternate for supplying needs farther in the future, however. Adding the estimated cost of the required complete treatment (i.e., $7 - $17 per acre foot) to the rate for Marin County delivered at Novato (i.e., $24 - $28 per acre foot) results in an estimated total cost of water for NMCWD of $31 - $45 per acre foot.

Marin Municipal Water District (MMWD) also has considered the North Bay Aqueduct but up to the present time has not decided for or against its utilization since the District's immediate future needs will be supplied from the almost completed Nicasio Project. In considering it as an alternate for meeting needs subsequent to

1/ Orlob, G. T . & Lindorf, M. R., Cost of Water Treatment in California, JAWWA, Vol. 50, No. 1, (Jan. 1958).

1970-1980, transmission costs from Novato to the boundaries of MMWD (i.e., estimated at $10 - $15 per acre foot) must be added to the estimated cost for NMCWD. This additional transmission cost would result in a total estimated cost for MMWD of $41 - $60 per acre foot.

Alternate III - Single-Purpose Storage Reservoir on Dry Creek (Water Supply Only)

A storage reservoir on Dry Creek for water supply only can be considered also as a likely alternate to the proposed multiple-purpose project of the Corps of Engineers.

The Corps has estimated the construction cost of such a reservoir (i.e., equivalent in yield to the proposed multiple-purpose reservoir - 90,000 acre feet per year total, 75,000 acre feet for municipal and industrial use) to be $21,700,000. Annual capital cost based on fifty year amortization and interest at 4% would be about $1,020,000. Operation and maintenance costs, including major replacements and a fish hatchery to mitigate detriments to fishery values, are estimated at $80,000 annually.

In the cost comparisons that follow, it is assumed that this additional water would be taken from the Russian River underflow, as at present, and would require only chlorination for municipal and industrial use.

North Marin County Water District's share of the costs of the reservoir, the intake development at a point near Mirabel and the transmission of the previously estimated Marin County share of water from Dry Creek (i.e., 37,000 acre feet annually) to Novato is estimated to be $35 - $40 per acre foot. Marin Municipal Water District's share of the cost plus the additional transmission cost from Novato would amount to $45 - $55 per acre foot.

Comparison of Alternates

Table 7 shows the comparison of costs for water (suitable for distribution to municipal and industrial customers) delivered to the two Marin County water districts from the three alternate sources.

TABLE 7

COSTS OF WATER FROM THREE ALTERNATE SOURCES TO MARIN COUNTY
(DOLLARS PER ACRE FOOT)

	Alternate I Walker Creek	Alternate II North Bay Aqueduct	Alternate III Single-Purpose Dry Creek Project
North Marin Co. Water District	52 - 67	31 - 45	35 - 40
Marin Municipal Water District	52 - 67	41 - 60	45 - 55

Translation of Costs to Multiple-Purpose Dry Creek Project Benefits

According to Table 7, Alternates II and III are the least costly and range around a central tendency of about $38 per acre foot for North Marin County Water District and $50 per acre foot for Marin Municipal Water District. It is concluded that either could be considered a likely alternate for Marin County. Since, in addition, Sonoma County has already directed their future planning to development of Russian River water, it also is concluded that Alternate III, the single-purpose Dry Creek Project, is reasonably the likely alternate for the purpose of determining municipal and industrial water supply benefits from the proposed multiple-purpose project on Dry Creek.

The estimated total annual cost (including amortization of the capital investment, operation and maintenance) of a single-purpose Dry Creek Project has been estimated by the Corps of Engineers as $1,100,000. The unit cost at the reservoir for water supply (90,000 acre feet per year total, 75,000 of which would be available for municipal and industrial use) from this alternative source is $12.22 per acre foot or 3.75 cents per thousand gallons. For the purpose of economic evaluation it is assumed that the physical life of the alternative single-purpose reservoir (as distinguished from the amortization period) is indefinite, but would be longer than fifty years.

It is concluded that the average future value of water supply yield for municipal and industrial use from the proposed multiple-purpose Dry Creek Project is $12.22 per acre foot. This future value applies to projected needs in Marin County which are expected to appear initially in about 1980 and increase to 75,000 acre feet annually between 2000 and 2005. Therefore, it should be discounted from 1980 (the assumed date of completion of the single-purpose alternative)

to the present or some other date to be determined by the Corps of Engineers as appropriate for comparison with other benefits and costs associated with the proposed project.

Review and Evaluation of Previous Studies of Municipal and Industrial Water Supply Needs in Mendocino, Sonoma, and Marin Counties as Related to Proposed Additional Development of Supply From the Russian River Basin

Southern Mendocino County

The area considered within Mendocino County consists generally of the Ukiah and Hopland Valleys. There are three separate communities in this area: Ukiah, Talmadge, and Hopland. Ukiah (1960 population of 9,820) is the largest of these, the county seat, and the principal trading center.

Present Water Supply - The total municipal and industrial use from all sources in 1957 was reported to be about 2,600 acre feet, and 1,700 acre feet of that quantity was drawn from either the surface or underflow of the Russian River. All demands in excess of 900 acre feet per year, therefore, must be met from the Russian River source, as there is no other supply available to meet these requirements of the population in Southern Mendocino County.

Future Water Requirements - Reports prepared by others and cited in "Water Use Survey on the Russian River in Southern Mendocino County", by Edward F. Carpenter, show populations expected in this area. A summary of these estimates is given in Table 1. It was observed that populations shown in the Carpenter report of 1959 are smaller than those predicted in the Whipple report of 1950. The information shown in the Carpenter report is used, as it is the latest information available.

In order to determine future water requirements, the growth during the 1957-1994 period was estimated. These estimated populations, the unit water use, and total estimated municipal and industrial water requirements are shown in Table 2.

Mendocino County has purchased 8,000 acre feet of firm yield from the Coyote Project on the Russian River. The estimated municipal and industrial water use of Southern Mendocino County is an ultimate 6,820 acre feet. For purposes of this report, it is assumed that

Mendocino County municipal and industrial water requirements will be met by the 8,000 acre feet until at least the year 2020.

Table 1

Population of Southern Mendocino County

Locality	Population	
	1957	1994 1/
Ukiah Area	11,200	31,000
Talmadge 2/	1,800	4,000
Hopland & East Hopland	530	900
TOTAL	13,530	35,900

1/ Base reports consider the 1994 population to be the ultimate development, and therefore that population would be applicable to all subsequent years.

2/ Not including Mendocino State Hospital.

Table 2

Estimated Municipal & Industrial Water Requirements of Southern Mendocino County

Year	Population	GPCD	Annual Use (Acre Ft.)
1957	13,530	-	2680
1960	15,000	170	2840
1970	19,000	170	3600
1980	22,000	170	4170
1990	30,000	170	5680
2000	36,000 1/	170	6820
2010	36,000	170	6820
2020	36,000	170	6820

1/ See Carpenter report, January 1958, page 41. Ultimate development expected by year 1994.

Santa Rosa Township (Sonoma County)

Present Water Supply - Prior to the completion of the Coyote Project on the Russian River, the City of Santa Rosa obtained its water from wells on the Santa Rosa Creek and a reservoir on Santa Rosa Creek. In 1949, the yield from Santa Rosa Creek was reported to be 3,696 acre feet. The cost was $38.6[illegible] per acre foot. The total municipal and industrial use in Santa Rosa Township in 1949 was reported to be 5,621, with the additional 1,925 acre feet coming from private supplies, presumably wells.

Previous to 1955, the Santa Rosa Board of Public Utilities had gone on record as being in need of an outside source of water supply. In June 1956, the Sonoma County Flood Control and Water Conservation District (SCFC & WCD) and the City of Santa Rosa entered into an agreement concerning a water supply from the Russian River. By contract, 14,000 acre feet of the Coyote Project supply is committed to Santa Rosa.

Future Water Requirements - The population forecasts and municipal and industrial water requirements prepared for the Whipple report are shown in Table 3. An estimate of water requirements, based on information developed in the RAPID TRANSIT SURVEY OF 1955, was prepared by John S. Langwell and is shown in Table 4.

For the purpose of planning future water development, it is believed desirable to use the maximum reasonable demand for municipal and industrial water supply. Past experience has shown that the provision of water supply seldom stays far ahead of the demand for water. Therefore, the Langwell (Table 4) projections for maximum growth rate will be used in considering total demand in the Santa Rosa area. However, it should also be remembered that probably 5,620 acre feet will be available from Santa Rosa Creek and underlying gravels.

Table 3

Estimated Municipal & Industrial Water Requirements of Santa Rosa Township

Year	Population	Water Demand (Acre Feet) 1/
1960	42,350	8,568
1970	51,300	7,937
1980	60,650	9,359
1990	69,550	10,717
2000	77,550	11,933
2010	87,000	13,300
2020	96,000	17,300

1/ Based on 140 GPCD in City, 100 GPCD in rural areas, plus industrial uses. (Whipple report)

Table 4

Estimated Municipal & Industrial Water Requirements of Santa Rosa Township

Yearly Demand	Probable Year of Demand	
	Maximum Growth Rate	Minimum Growth Rate
ACRE FEET	YEAR	YEAR
5,333	1957	1959
6,000	1960	1963
6,280	1960	1965
8,000	1966	1976
8,905	1969	1984
10,000	1972	1992
11,000	1976	Beyond year 2000
12,000	1979	" " "
13,162	1983	" " "
14,000	1986	" " "
15,000	1990	" " "
18,000	2000	" " "
22,000	2010	" " "
26,000	2020	" " "

Petaluma Township (Sonoma County)

Present Water Supply - The present water supply and the future water requirements for Petaluma Township are documented in a report on the Petaluma Aqueduct prepared by the Sonoma County Flood Control and Water Conservation District in March 1959. Pertinent information has been drawn from that document.

The municipal areas in Petaluma Township, presently served by organized water companies, are Petaluma, Cotati, Penngrove, and Rohnert Park. The Petaluma System is municipally owned (recently purchased from the California Water Service Company) and is served from wells and a surface reservoir. It has approximately 5,084 metered connections. Penngrove is served by the Penngrove Water Company from a single well, with approximately 110 metered connections. Rohnert Park is served by a privately owned water system from a single well.

The ground water supply from wells in Petaluma Township is evidently diminishing and there has been some difficulty in expanding water production to meet increasing demands. There is also some evidence of salt water intrusion during the fall months, as reported in the Paul Nichols' report of March 15, 1955. Based on historical water use in the area, it appears that the safe yield from wells would be about 1,000 acre feet per year. Demands in excess of that quantity should be met from other sources.

Future Water Requirements - The estimated annual use of water for Petaluma Township is shown in Table 5. It is presumed that the 1,000 acre feet ultimately will be used by population not served by the Petaluma aqueduct and will not be available to meet demands estimated in Table 5.

Sonoma Township (Sonoma County)

Present Water Supply - The community areas in Sonoma Township presently served by organized water companies are Kenwood, Glen Ellen, Donaghy Tract, Aqua Caliente, Fetters Hot Springs, Boyes Springs Village, Boyes Hot Springs, El Verano, and the City of Sonoma. All of these communities are served by wells.

In addition to the above communities, there is Los Guilucos School for Girls, the Sonoma State Hospital at Eldridge, and the Archbishop Hanna Center for Boys. Except for the hospital, these institutions are also served by wells. The hospital is served by two surface storage reservoirs on the grounds and some pumping from Sonoma Creek.

The ground water supply from wells in the Sonoma Township is evidently diminishing and there has been some difficulty in expanding water production to meet increasing demands. There is also some evidence of salt water intrusion in wells in some of the areas south of the City of Sonoma.

From historical use data, it appears that the maximum water supply available annually from local sources, including wells, is about 1,000 acre feet.

Table 5

Estimated Municipal and Industrial
Water Requirements of Petaluma Township

Year	Population Using Petaluma Aqueduct Supply	Estimated Use (gpcd)	Estimated Annual Use (Acre Feet)
1960	18,000	100	2,000
1970	24,000	112	3,000
1980	32,000	125	4,500
1990	43,000	137	6,600
2000	56,000	150	9,400
2010	72,000	160	12,900
2020	80,000	170	15,200

Future Water Supply - All of Sonoma Township, together with the area lying within the Sonoma Valley between the Santa Rosa service area and the northerly Sonoma Township line, is considered a potential user of water delivered by the proposed Sonoma Aqueduct, and is called the Sonoma Aqueduct service area.

The Sonoma County Flood Control and Water Conservation District has prepared an estimate of the future population and water use in the service area. This estimate and extensions to the year 2020 are shown in Table 6.

The development of Table 6 anticipated that a part of the area population would not be served by the aqueduct, and it can be assumed that the 1,000 acre feet of supply from wells would serve this population and a portion of the hospital's requirements. Therefore, all requirements shown in Table 6 must be met from imported supplies.

Table 6

Estimated Municipal and Industrial
Water Requirements of Sonoma Aqueduct Service Area

Year	Population Served	Unit Use (gpcd)	State Hospital Acre Feet/Yr.	Annual Water Use Acre Feet
1960	15,500	100	365	2,100
1970	23,800	112	730	3,720
1980	32,100	125	730	5,230
1990	41,500	137	730	7,110
2000	53,100	150	730	9,660
2010	78,000	160	730	14,630
2020	95,000	170	730	18,780

Windsor County Water District (Sonoma County)

Present Water Supply - The present source of water supply for domestic purposes in the Windsor service area is private wells. These wells vary widely in yield and quality of water.

Future Water Requirements. As no past population figures of the service area were available to establish a rate of population increase, it was assumed that the population growth would parallel that projected population growth for Sonoma County. The population and water requirements for the Windsor Water District have been developed by the Sonoma County Flood Control and Water Conservation District and are shown in Table 7. Water requirements shown in Table 7 must be met from imported supplies. It is assumed that the population not using the aqueduct waters must use available ground waters.

Table 7

Estimated Municipal and Industrial
Water Requirements for Windsor Water District

Year	Customers	Unit Use (gpcd)	Annual Use Acre Feet
1960	1,160	100	131
1970	1,570	112	198
1980	2,120	125	298
1990	2,860	137	440
2000	3,830	150	646
2010	4,680	160	835
2020	5,600	170	1,060

Sebastopol Aqueduct Service Area (Sonoma County)

The area considered includes the City of Sebastopol and the communities of Forestville, Mirabel Park, and Graton. This area is estimated to provide the greatest benefit to the greatest number of people interested in the importance of water.

Present Water Supply - There are four private water companies as well as the City of Sebastopol Municipal Water Company presently serving the area. All supplies are from wells.

The City of Sebastopol borders on the westerly edge of the Santa Rosa Valley, adjacent to thick deposits of sand and gravel under the former Russian River flood plain. Wells in this deposit have a good yield. The favorable position of Sebastopol is not shared by either Mirabel, Forestville or Graton.

Future Water Requirements - Water requirements have been developed from estimates of future populations, unit water uses, and future water requirements for this service area are shown in Table 8.

The demands shown in Table 8 are assumed to be requirements which should be met by imported water. The number of customers shown in the Table 8 is not the total population but is the number which would be served by the aqueduct. The remaining population could be served by existing supplies.

Table 8

Estimated Municipal and Industrial
Water Requirements for the Sebastopol Aqueduct Service Area

Year	Customers	Unit Use (gpcd)	Industrial Use (Acre Feet/ Year)	Total Annual Use (Acre Feet/ Year)
1960	6,000	115	92	892
1970	11,200	137	92	1,792
1980	15,200	150	92	2,692
1990	20,400	150	92	3,592
2000	26,100	150	92	4,492
2010	31,000	150	92	5,292
2020	36,000	150	92	6,092

North Marin Water District (Marin County)

Prior to the formation of the District, the area was served by the Novato Water Company. This company was serving 740 water connections in 1949 when it was purchased by the District. The source of supply was well water. The depletion of the ground water and population growth resulted in serious water shortages in the late 1940's and was primarily responsible for the formation of the District on April 13, 1948.

The District covers approximately half of Novato Township. The area in the Township outside the District is primarily rugged hills within which only sparse residential development is likely.

Present Water Supply - In the absence of a large ground water source, the District developed a surface water supply by impounding water with the Stafford Dam on Novato Creek. The dam was originally built in 1951 with the spillway crest at elevation 180 and a gross storage capacity of 1,710 acre feet which yielded about 1,150 acre feet per year. In October 1954, the spillway crest was raised to elevation 195, increasing the storage capacity to 4,430 acre feet and its net estimated safe yield to 1,910 acre feet per year. It is believed not to be economical to further increase the height of this dam.

Population growth during the past ten-year period from 3,000 to 17,500 has far exceeded the projections that were made in planning the first District facilities. In the past several years, the District has found that it is rapidly approaching the limit of its facilities in making water available throughout its system. The water demand in 1960 was 2,800 acre feet.

Future Water Supply - By combining estimated populations and unit water use plus industrial water requirements, future water supply requirements have been developed and are shown in Table 9.

As the ground water supply is small, it can be assumed that requirements shown in Table 9 should be met by additional surface water supplies to supplement the existing 1,910 acre feet supply in Stafford Lake.

Table 9

Estimated Municipal and Industrial
Water Requirements for the North Marin County Water District

Year	Demand (Acre Feet) 1/
1960	2,800
1970	6,800
1980	11,300
1990	16,400
2000	23,600
2010	33,000
2020	43,000

1/ Modification of data from North Marin County Water District Report.

Marin Municipal Water District (Marin County)

Present Water Supply - The present water supply of Marin Municipal Water District includes four surface water storage projects which have a net safe yield of 15,200 acre feet and an annual normal operating supply of 20,000 acre feet. Existing gross storage amounts to 30,000 acre feet. During 1959, the annual use was 18,500 acre feet.

Future Water Requirements - The Nicasio Project is now under construction and is scheduled to be completed prior to the winter of 1960-61. The net safe yield, including the Nicasio Reservoir, will then be 30,200 acre feet, and the annual normal operating supply will be 38,000 acre feet.

The water supply requirements of Marin Municipal Water District have been developed and are shown in Table 10.

Marin County Total Future Water Requirements - Estimates of water requirements for the whole of Marin County have been made and are shown in Table 11. These indicate that the total water requirements in 1990 will be 60,500 acre feet per year and by the year 2020, this demand will increase to 98,000 acre feet. At present, the total safe yield of public projects amounts to only 17,000 acre feet per year. This supply will shortly be increased to 32,000 acre feet with the completion of the Nicasio Project. (About 1,000 acre feet, developable from ground water, will be considered as available for use by individual domestic, commercial, etc., users.) Therefore, it appears that Marin County water districts must develop or import 64,000 acre feet by the year 2020 in order to meet projected demands.

Table 10.

Estimated Municipal and Industrial
Water Requirements for Marin Municipal Water District

Year	Demand 1/ (Acre Feet)
1960	19,400
1970	29,800
1980	37,900
1990	44,150
2000	48,800
2010	52,200
2020	55,000

1/ Modification of data from Marin Municipal Water District Report.

Table 11

Estimated Municipal and Industrial
Water Requirements of Marin County

Year	Demand (Acre Feet)
1960	22,200
1970	36,600
1980	49,200
1990	60,500
2000	72,400
2010	85,200
2020	98,000

Sonoma County Total Future Water Requirements

Individual townships have been considered for water supply and aqueducts which have been planned to serve the several communities contained therein. The aqueducts have been planned for a water use expected in 1980.

It was noted that the population planned to be served by the several aqueducts ranged from 50 to 90 percent of the total population of the area. In the 1960-1970 period, the difference might reflect the population in other communities, fringe areas, etc. (including, for example, Healdsburg), which can conveniently be served from well supplies exclusively. For the purpose of these projections, it is estimated that this population served exclusively by wells will not be more than 100,000.

As projections are made further into the future, the difference between estimated total populations and estimated populations served by existing supplies supplemented by aqueducts becomes larger. It is believed that additional aqueduct capacity and additional service areas will be developed to serve all but the previously estimated maximum of 100,000 population to be served by wells. This estimated additional population, which will generate a demand, is shown in Table 12, and the estimated demand is shown in Table 13.

Table 12

Projected Increase in Population to be Served by Additional Aqueduct Capacity - Sonoma County

Area	Year						
	1960	1970	1980	1990	2000	2010	2020
Sonoma County	145,800	178,000	300,000	468,000	540,000	838,000	1,114,000
Sonoma County Aqueduct Service Areas for Which Supplies Have Been Planned:							
Santa Rosa	42,350	51,300	60,650	69,500	77,550	87,000	96,000
Sonoma	15,500	23,800	32,100	41,500	53,100	78,000	95,000
Petaluma	18,000	24,000	32,000	43,000	56,000	72,000	80,000
Sebastopol	6,000	11,200	15,200	20,400	26,100	31,000	36,000
Windsor	1,160	1,570	2,120	2,860	3,830	4,680	5,600
	83,010	111,870	142,070	177,310	216,580	272,680	312,600
Difference Between Total County Population & Population Served by Planned Aqueduct Supplies	62,800	66,000	158,000	291,000	323,000	565,000	801,000
Population Served By Wells (Community, fringe area or rural)	62,800	66,000	100,000	100,000	100,000	100,000	100,000
Additional Population of Sonoma County	-0-	-0-	58,000	191,000	223,000	465,000	701,000

Table 13

Estimated Additional Municipal and Industrial Water Use in Sonoma County Not Previously Considered (Based on Table 12 Projections)

Year	Additional Population	Unit Water Use (gpcd)	Annual Use (Acre Feet)
1960	-0-	--	--
1970	-0-	--	--
1980	58,000	125	8,100
1990	191,000	137	29,200
2000	223,000	150	37,400
2010	465,000	160	83,000
2020	701,000	170	133,000

Total Municipal and Industrial Requirements in Marin and Sonoma Counties for Additional Russian River Water Development and Transmission through Aqueducts

Tables 14-20 show a comparison between the existing supplies of surface and ground water to the total demand of the areas. The result is the additional supply needed for the area.

Table 14

Estimated Municipal and Industrial Water Supply Needs
for Additional Russian River Water Development
Marin and Sonoma Counties
Year 1960

Location	Existing Surface and Ground Water Supplies Used to Meet Demands Shown 1/ (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)
Santa Rosa	19,620	6,568	0
Petaluma	4,500	2,000	0
Sonoma	5,200	2,100	0
Windsor	(In 4,700 of Sonoma Co.)	131	0
Sebastopol	2,600	892	0
Sonoma Co. - Other	4,700	-	0
North Marin W.D.	11,910	2,800	0
Marin Municipal W.D.	30,200	19,400	0
		NEED 2/ =	0

1/ Includes distribution of Coyote Project Water and anticipated distribution.

2/ Need is based upon available water storage, previous commitments, and assumption that distribution facilities will be built as required.

Table 15

Estimated Municipal and Industrial Water Supply Needs
for Additional Russian River Water Development
Marin and Sonoma Counties
Year 1970

Location	Existing Surface and Ground Water Supplies Used to Meet Demands Shown (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)
Santa Rosa	19,620	7,937	0
Petaluma	4,500	3,000	0
Sonoma	5,200	3,720	0
Windsor	(In 4,700 of Sonoma Co.)	198	0
Sebastopol	2,600	1,792	0
Sonoma Co. - Other	4,700	-	0
North Marin W. D.	11,910	6,800	0
Marin Municipal W. D.	30,200	29,800	0
		NEED =	0

Table 16

Estimated Municipal and Industrial Water Supply Needs
Marin and Sonoma Counties
Year 1980

Location	Existing Surface and Ground Water Supplies Used to Meet Demands Shown [1] (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)	
Santa Rosa	19,620	9,359	0	
Petaluma	4,500	4,500	0	
Sonoma	5,200	5,230	30	
Windsor	-	298	298	
Sebastopol	2,600	2,692	92	
Sonoma Co. - Other	4,700	8,100	3,400	3,800 [2]
North Marin W. D.	11,910	11,300	0	
Marin Municipal W. D.	30,200	37,900	7,700	7,700 [2]
Unassigned Sonoma Co. Coyote Water	11,000	--	--	
		TOTAL	=	11,500
		NEED [1]	=	500

1/ Temporarily on a year-to-year contract, water might be available from Santa Rosa and Sonoma County, if aqueducts to Marin Municipal Water District are constructed by the year 1980. The unassigned 11,000 acre feet belonging to Sonoma County might be used to satisfy additional needs of Sonoma, Windsor, Sebastopol, and other communities of Sonoma County, totaling 3,820 acre feet.

2/ Rounded off to nearest 100 acre feet.

Table 17

Estimated Municipal and Industrial Water Supply Needs
Marin and Sonoma Counties
Year 1990

Location	Existing Surface And Ground Water Supplies Used to Meet Demands Shown 1/ (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)	
Santa Rosa	19,620	10,717	0	
Petaluma	4,500	6,600	2,100	
Sonoma	5,200	7,110	1,910	
Windsor	-	440	440	
Sebastopol	2,600	3,592	992	
Sonoma Co. - Other	4,700	29,200	24,500	29,940 1/
North Marin W. D.	11,910	16,400	4,510	
Marin Municipal W. D.	30,200	44,150	13,950	18,460
Unassigned Sonoma Co. Coyote Water	11,000	--	--	
			TOTAL =	48,400
Sonoma County Additional Demand			29,940	
Sonoma County Unassigned			11,000	
Sonoma County Additional Requirement			=	18,940
Marin County Additional Requirement			=	18,460
			NEED =	37,400

1/ Rounded off to nearest 100 acre feet.

Table 18

Estimated Municipal and Industrial Water Supply Needs
Marin and Sonoma Counties
Year 2000

Location	Existing Surface and Ground Water Supplies Used to Meet Demands Shown 1/ (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)	
Santa Rosa	19,620	11,933	0	
Petaluma	4,500	9,400	4,900	
Sonoma	5,200	9,660	4,460	
Windsor	-	646	646	
Sebastopol	2,600	4,492	1,892	
Sonoma Co. - Other	4,700	37,400	32,700	44,600 1/
North Marin W.D.	11,910	23,600	11,690	
Marin Municipal W.D.	30,200	48,800	18,600	30,290
Unassigned Sonoma Co. Coyote Water	11,000	--	--	
			TOTAL =	74,890
Sonoma County Additional Demand			44,600	
Sonoma County Unassigned			11,000	
Sonoma County Additional Requirement			=	33,600
Marin County Additional Requirement			=	30,290
			NEED =	63,900 1/

1/ Rounded off to nearest 100 acre feet.

Table 19

Estimated Municipal and Industrial Water Supply Needs
Marin and Sonoma Counties
Year 2010

Location	Existing Surface And Ground Water Supplies Used to Meet Demands Shown 1/ (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)	
Santa Rosa	19,620	13,300	0	
Petaluma	4,500	12,900	8,400	
Sonoma	5,200	14,630	9,430	
Windsor	-	835	835	
Sebastopol	2,600	5,292	2,692	
Sonoma Co. - Other	4,700	83,000	78,300	99,660 1/
North Marin W. D.	11,910	33,000	21,090	
Marin Municipal W. D.	30,200	52,200	22,000	43,090
Unassigned Sonoma Co. Coyote Water	11,000	--	--	
			TOTAL =	142,750
Sonoma County Additional Demand			99,660	
Sonoma County Unassigned			11,000	
Sonoma County Additional Requirement			=	88,660
Marin County Additional Requirement			=	43,090
			NEED =	131,750

1/ Rounded off to nearest 100 acre feet.

Table 20

Estimated Municipal and Industrial Water Supply Needs
Marin and Sonoma Counties
Year 2020

Location	Existing Surface And Ground Water Supplies Used to Meet Demands Shown 1/ (Acre Feet)	Total Demand (Acre Feet)	Additional Supply Required (Acre Feet)	
Santa Rosa	19,620	17,300	0	
Petaluma	4,500	15,200	10,700	
Sonoma	5,200	18,780	13,580	
Windsor	-	1,060	1,060	
Sebastopol	2,600	6,092	3,492	
Sonoma Co. - Other	4,700	133,000	128,300	157,130 1/
North Marin W. D.	11,910	43,000	31,090	
Marin Municipal W. D.	30,200	55,000	24,800	55,890
Unassigned Sonoma Co. Coyote Water	11,000	--	--	
			TOTAL =	213,020
Sonoma County Additional Demand			157,130	
Sonoma County Unassigned			11,000	
Sonoma County Additional Requirement			=	146,130
Marin County Additional Requirement			=	55,890
			NEED =	202,000 1/

1/ Rounded off to nearest 100 acre feet.

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